ABSTRAK

Indonesia faces significant challenges in disaster mitigation due to its geographical location along the Pacific Ring of Fire and its extensive archipelagic topography. Limited communication infrastructure in remote areas results in delayed distribution of sensor data and evacuation orders during disasters. Therefore, a communication solution that does not rely on conventional networks, yet remains energy-efficient and reliable in various environmental conditions, is required.

This research designs and builds a prototype Ground Control Station (GCS) based on LoRa technology integrated with the PocketCube satellite, focusing on testing communication range up to 11 km under Line-of-Sight (LOS) conditions in an open urban environment. The system was designed using an ESP32 microcontroller and an SX1276 LoRa module (TTGO T3 v1.6.1), then experimentally tested for signal strength (RSSI), transmission delay, and device reliability across various temperatures (−20°C to 40°C) and power consumption modes (active, idle, sleep).

The main results show that the system can maintain reliable communication at a distance of 11 km with consistent RSSI values ranging from −100 to −107 dBm and an average delay of 1 second. This serves as empirical validation that long-range LoRa communication can be reliable in real-world scenarios without GSM infrastructure. Additionally, the system has high power efficiency, consuming only 0.25–0.35 watts per minute in sleep and idle modes. With these results, the prototype demonstrates strong potential as a solution for ground control station communication and satellite-based emergency communication in remote areas, particularly in the context of early warning systems and disaster management in Indonesia.

Keywords: *LoRa, Ground Control Station, long-range communication, disaster mitigation, line-of-sight, RSSI*